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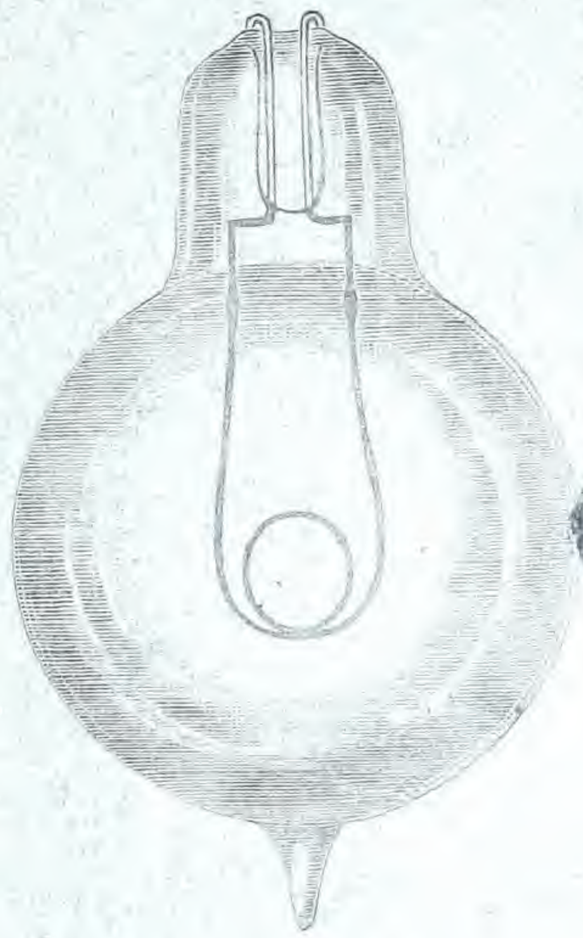
BRUSH-SWAN

Electric Light



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The Swan Incandescent Electric Lamp,

The Brush Arc Light and Storage Systems.

BRUSH-SWAN

ELECTRIC LIGHT

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The Swan Incandescent Electric Lamp,

THE BRUSH ARC LIGHT AND STORAGE SYSTEMS.

NEW YORK, JANUARY, 1883.

The Swan Incandescent Electric Lamp.

THE difficulty of dividing the electric current for the economical production of incandescent light has been practically solved by the invention of the Swan Incandescent Lamp. By its means separate lights of various powers and applicable to all the uses of ordinary gas burners, or other artificial light, may be produced. The Swan Lamp may be fed direct from the dynamo-electric machine, or from secondary batteries or from other available sources of electricity.

THE LAMP.

The Swan Lamp is extremely simple in its construction and may be described as follows : a small glass globe from which all the air has been exhausted, and in which is fixed a thin filament of carbon.

On passing the electric current through the carbon it becomes intensely white hot and emits a beautifully soft, clear and steady light. As the carbon is not in contact with the air there is no combustion, and, therefore, no deterioration of the atmosphere of the room in which it is used, and the heat given off is imperceptible.

The lamp has no mechanism and when it fails from use or accidental breakage is as easily replaced by a new one as a candle is placed in a candle-stick.

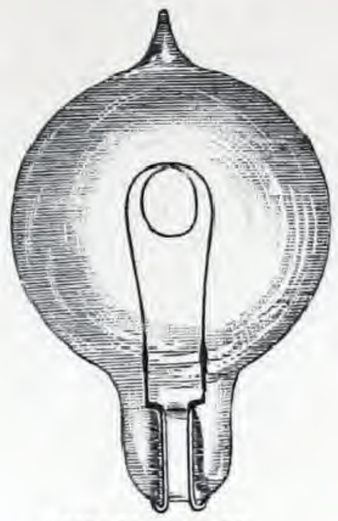
The power of the Swan Lamp ranges from 3 candles to 100 candles, the standard size, however, being 16 candles, or somewhat more than an ordinary gas burner.

LAMP FIXTURES.

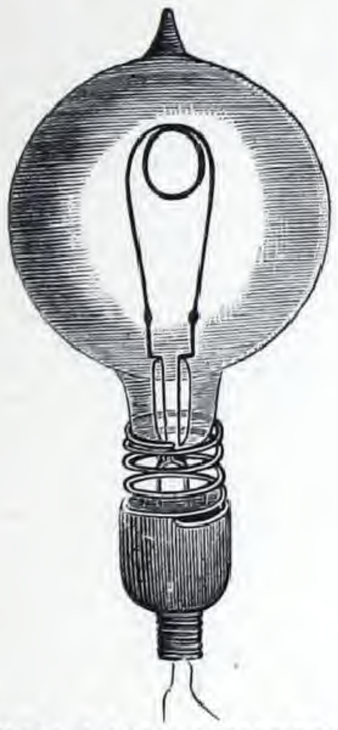
The Swan Lamp can be adapted with small cost to existing gas fittings, by simply unscrewing the gas burner and attaching the lamp. When desired it can be used with oil lamp fittings. Special fixtures, electroliers, chandeliers and brackets of various elegant designs are furnished with the lamps when ordered.

The light is turned off or on by means of a key, or button, made of rubber, and each lamp is entirely independent of the others or they may be arranged in groups if desired. Chandeliers arranged for any number of lights, and from standard or special designs if required, are furnished by the Swan Company. These may be arranged so that one lamp or a series of lamps may be turned off or on at will

HOLDER SWAN LAMP.



SWAN LAMP.



SWAN LAMP COMPLETE.

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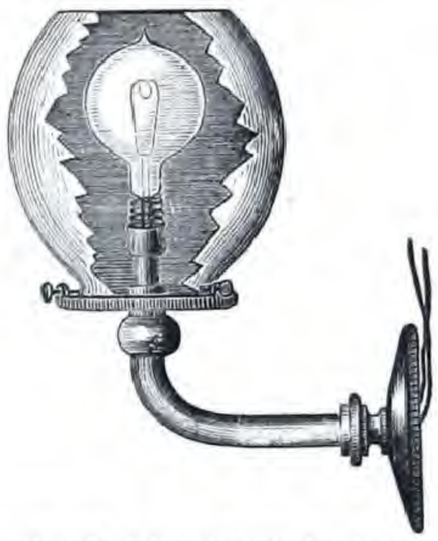
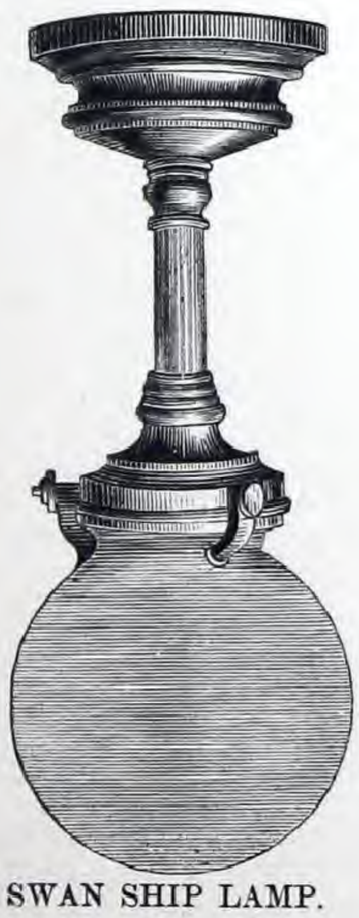


SWAN BRACKET LAMP.



SWAN SHIP LAMP.

SWAN TABLE LAMP.

Safety Plugs and Wires.

Each lamp is provided with a safety attachment so that in case of accident to the line by short circuiting, the circuit is instantly broken. The wires leading to the fittings are perfectly insulated in a fire-proof material, thereby absolutely preventing any danger from fire. They may be run between walls and floors and through partitions with perfect safety, or they may be enclosed in ornamental wood strips crossing the ceilings and easy of access.

There is no danger to property, life, or health in the use of the Swan Lamp. It is non-explosive. Every fixture, wire, and key is insulated to further secure the entire safety of the user.

Swan Light for Health and Comfort.

The age demands an illuminant that offers a practical remedy for the many disadvantages and annoyances of gas. Without taking into account the many deaths and destructive fires resulting from the use of gas there is involved in its use countless other baneful effects. An English writer says that the evil effects of the heat of gas jets are augmented by the large amount of water produced by the flame. Sixty burners will produce two gallons of water per hour; hence in an evening many large shops filled with delicate goods will have a nine gallon caskful of water thrown into their atmosphere in the form of steam, to condense on any cool surface, as we often see it trickling down the windows in winter. But worse remains behind. The sulphur, always present in gas, burns into sulphurous vapor, and changes in the air to oil of vitriol, which is very destructive of health. The fumes from gas will indeed, in the long run, discolor every sort of fabric, rust metals, rot gutta percha, and reduce leather (as in the binding of books) to 'a scarcely coherent powder with a strongly acid taste. Drapers know to their cost how the edges of pieces of dyed fabrics become faded and rotten when kept long on the shelves of gas lighted shops; no plant will grow in a room where gas is burning, and cut flowers quickly wither; while those who work long and habitually in gas-lighted rooms become blanched and sickly.

The flaring and hissing so well known and so troublesome where there are variable gas pressures; the disagreeable smells of half-burnt gas and the consequent headaches and feeling of oppression so prevalent where gas is freely burned; the filling of the atmosphere with carbonic acid gas, and the destruction of valuable furnishings; are all obviated by the use of the silent, steady, bright and clean Swan Lamp. Those who are in the habit of reading and writing and who prefer the badly smelling oil lamp to the flickering, flaring gas burner so hurtful to the eye-sight will welcome the healthful, agreeable substitution for both, of the Swan Lamp.

The Brush Electric Light.

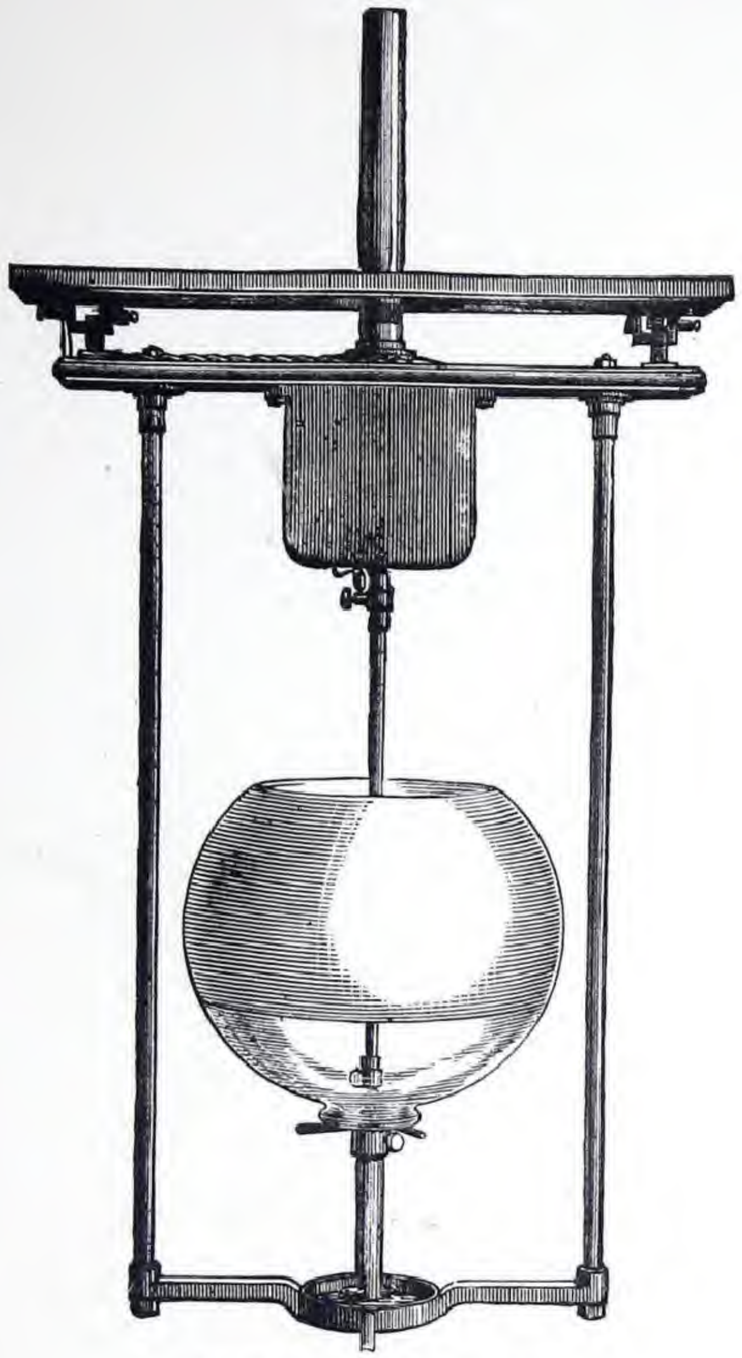
Electric illumination is rapidly advancing, not only in the United States, but throughout Great Britain, the Continent of Europe, India, Australia, Mexico, South America, China, Japan and elsewhere.

The number of electric lighting Companies is steadily increasing from day to day. A large amount of capital has already found in this new field a safe and remunerative investment, and the demand for the light is in excess of the ability of the companies to furnish it. In this country, as elsewhere, the lights are used by cities and towns for the lighting of streets, parks, public buildings, etc. ; by railroad companies for the lighting of their stations, switch yards and shops ; by manufacturing concerns of every description for lighting their mills, factories, shops and yards, and by ocean, lake and river steamers, in the varied operations of navigation, loading, making landings, unloading and other work. Mining operations of all kinds are carried on by their means and there are few departments of industry or labor in which the Brush Electric Light has not already occupied the field and demonstrated its success. In these and similar ways over 18,000 Brush arc lights are now in use in the United States, and nearly one hundred Companies have already been formed in various cities and towns in this country to furnish the light as a legitimate business. It is estimated that the aggregate earnings of these lights the past year exceeded four million dollars, and that there is a total capital of seven millions of dollars employed in companies alone.

All of the subsidiary organizations under the parent company are steadily increasing their business, more especially in the larger cities and towns, and most of the stocks of these companies are either held at a considerable premium or are not in the market at all.

The success of the Brush system has been no less marked abroad than here, and it has been unequalled by all other systems combined. A large business has been transacted by the Anglo-American Brush Company of London and its works and connections are of the most extensive character. The Admiralty, the War Department, the committee of Council on Education, the Post Office, the Corporation of the City of London, the Great Western, the Great Eastern, and the Midland Railways, and many other great public corporations are among the users of the Brush light.

The excellence of the Brush system of Electric lighting is acknowledged not only for the brilliancy, steadiness and uniformity of the Light but also for its great economy. Under the Brush system any number of arc lamps from 1 to 40, each of 2,000 candle-power, or any number from 1 to 15, each of 6,000 candle-power, or a single light of 100,000 candle-power can be produced from a single dynamo machine. The conducting wires may be extended over circuits of many miles and thus from one centre a large district can be economically lighted.



BRUSH SINGLE LAMP.

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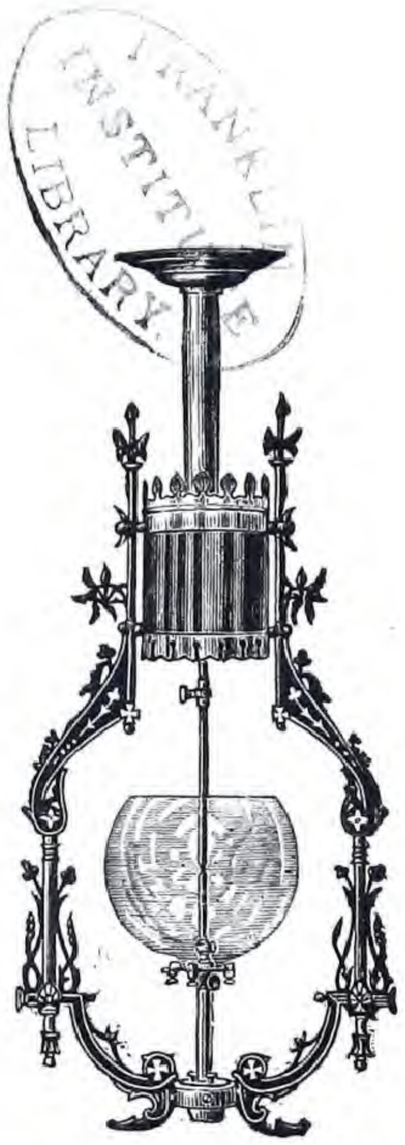
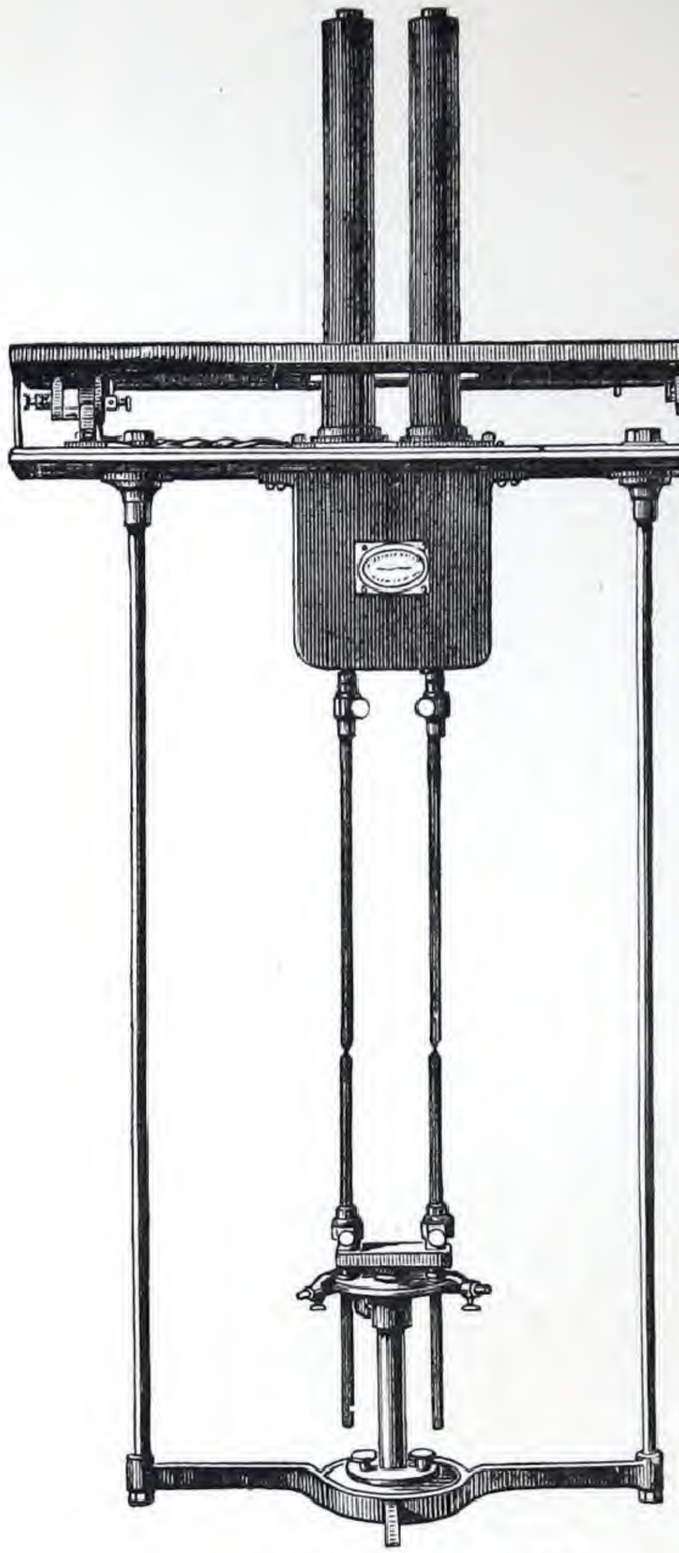


BRUSH ORNAMENTAL LAMP.



BRUSH DOUBLE LAMP.

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API INTERNATIONAL

CCA

Advantages of Electric over other Artificial Lights.

Safety to Life and Property. The Brush Electric Light Apparatus, with wires properly insulated furnishes the safest artificial light of large power known. Competent Insurance and Scientific experts agree as to this.

Economy. It is the cheapest illuminator known. In the majority of cases it is furnished at a much less cost than the gas or oil it displaces, giving at the same time a greatly increased amount and better quality of light.

Perfect Control. In public street lighting the lamps may be turned on or off from a central station and thus a whole city may be lighted instantaneously. The lighting of large buildings or factories may be arranged so as to be controlled from one point, or each light may be independent of all others.

Pure Air. It does not vitiate the atmosphere as do gas and oil.

No Heat. Little or no heat is given off.

Cleanliness. It does not generate impurities to destroy pictures, paper and other decorations.

Color. Being white like sun light, the difference in the most delicate shades of color is clearly seen, rendering it invaluable to manufacturers and merchants.

No Matches. The use of matches (the present cause of many fires) is avoided.

Steadiness. As it is not affected by wind, draft or storm, it burns steadily.

The Brush Arc Light.

The Brush System of Electric lighting differs from all others in that it is COMPLETE IN ITSELF and is fully protected by foundation patents granted to Mr. Brush. These inventions and patents cover the dynamo electric machine, with its automatic current governor or regulator; the arc lamps, provided with automatic cut out; the carbons, and the apparatus for storing electricity. The latter consists of the accumulator or secondary battery, the automatic charging and discharging apparatus or current manipulator, and the meter for measuring the amount of current. All the above are fully covered by patents issued to Charles F. Brush Ph. D., their inventor, and can only be LAWFULLY MANUFACTURED BY his licensees, The Brush Electric Company of Cleveland. Notwithstanding this fact, in order to produce a light in any degree rivaling the Brush, opposition companies have been compelled to either retire from business or unscrupulously use the Brush patents. Parties contemplating introducing the electric light will do well to examine into this question of infringements.

THE RIGHT AND TITLE OF THE BRUSH ELECTRIC COMPANY TO APPARATUS MANUFACTURED BY IT ARE UNQUESTIONED.

By the Brush system of constructing machines it is possible to produce from a single machine a large number of lights in series on one circuit. One hundred or even more lights of any size from 1,000 to 100,000 candle power may be produced. The size of the Brush machine most in demand is the one producing forty lights of two thousand candle power each, of which size about 300 are in use. Other sizes produce from one to twenty lights each, and require about eight-ninths horse power per light.

This light, owing to its great power and brilliancy, is especially adapted for use in large spaces, such as stores, factories, halls, streets, parks, harbors, lighthouses, etc. Lighting Companies for renting this light to individuals who have not the necessary machinery to produce it for themselves, have been organized in nearly all large cities of the country, including New York City; Albany; Buffalo; Rochester; Niagara Falls; Boston; Philadelphia; Pittsburgh; Cleveland; Cincinnati; Toledo; Baltimore; Indianapolis; Chicago; Aurora, Ill; Ottawa, Ill; Detroit; Grand Rapids; Alpena; New Orleans; Denver; Salt Lake City; Ogden, U. T; San Francisco; Galveston; Topeka; Louisville; Butler, Mo.; St. Joseph; Fargo, D. T.; La Crosse, Wis.; Nashville; Chattanooga; Atlanta, Geo.; Helena, Butte, Montana; Savannah, Macon, Ga.; Columbus, Ga.; Memphis, Tenn.; Minneapolis; St. Paul; Fergus, Minn.; Evansville, Ind.; Cheyenne, Wyoming, and other places.

In many of these cities contracts have been made to light the public streets; Albany alone using about four hundred such lamps, and other cities using from one hundred to three hundred.

The following are among the

ADVANTAGES OF THIS OVER OTHER ARC LIGHTS.

More light is produced from a given power than by any other system.

At the recent Paris Electrical Exhibition accurate measurements were made of the amount of light per horse power produced by the various systems of lights there exhibited, and from this official report the following figures are extracted:

Actual amount of light produced for each horse power of energy in the lamps:

Brush System,	.....	2,427	Candle	Power.
Cance	"	1,983	"	"
Crompton	"	1,890	"	"
Weston	"	1,881	"	"
Pilsen	"	1,345	"	"
Gravier	"	1,189	"	"
Serrin	"	1,123	"	"

More lights can be run on one circuit.

Longer circuits can be used.

Wire of smaller size can be used to conduct the current without material loss.

Lights are steadier, whiter, and more powerful.

For these reasons the Brush lights have met with a larger sale than those of all other systems in this country combined.

The works of the parent company, at Cleveland, are the largest of the kind in the world, and their business, during the year just ended, has been the largest in the history of the Company. They have recently added very greatly to their plant for the purpose of providing power for the manufacture o storage batteries.

The Brush lights used and operated by individuals and firms outside of Lighting Companies in this country, are divided about as follows :

Rolling Mills, Iron and Steel Works, Machine Shops, etc.	1,500
Woolen, Cotton, Linen and Silk Factories,	2,000
Large Stores	600
Parks, Docks, Summer Resorts, &c.,	400
Mines, Smelting Works, &c.	200
Lumber and Saw Mills,	200
Rail Road Companies,	500
Hotels,	200
93 Steamers, using	200
Factories and Establishments of various kinds,	2,500
Total	8,300

Besides these about 10,000 are being used for rental by the various lighting companies.

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High and Low Tension Dynamos.

Up to the present time in this country all incandescent electric lighting has been done directly from dynamo machines, and the system has proven so costly as generally to exceed the cost of other methods of artificial illumination. This has militated against the more rapid introduction of the light, both for isolated lighting and for lighting from central distributing stations, and has necessitated the invention of a system that would remedy the serious objections to prevailing methods. Machines furnishing a quantity current, such as have been used for this purpose, instead of intensity, now to be used, have been unable economically to overcome the resistance in long circuits and have proven impracticable except for continuous use in very limited areas.

Dynamo Machines.

Are of two kinds, low tension or quantity current machines, such as the Siemens, and others; and high tension or intensity machines, the best type of which is the Brush.

Low Tension Machines

have proven a failure in furnishing electricity from central stations for general illuminating purposes so far as the economical production of the light is concerned. The reasons are obvious: In order to supply current economically there should be as little resistance in the line as possible, that is, the conductors should absorb the least possible amount of current. As every foot of wire offers a certain amount of resistance to the passage of the current, it is plain that at a certain distance from the generator this becomes a constantly increasing charge on the light. Dr. Siemens estimated that the cost of conductors to convey current from a low tension machine in a given district a quarter of a mile square would be six times as great as the cost of conductors to carry current from a high tension machine for the same district.* The cost of maintenance is correspondingly great, being estimated to be three times as much in the amount of power required, that is to say :

Given, an electric lighting plant of a certain capacity, capable of furnishing at the generator, with a low tension machine, nine lights to the horse-power, when the lines are extended into even the most limited area practicable for general illuminating purposes, the efficiency decreases to less than three lights to the horse-power as shown by actual experiment.

Given, a plant of similar capacity with high tension machines, and the loss due to resistance would be reduced to less than one light in nine, so that it is possible to deliver more than eight lights to the horse-power at any point within the area to be lighted.

Here electricians are met with the most important problem of electric lighting from

Central Stations.

In either of the above cases, to supply the maximum amount of light required at any moment the demand may be made, requires the maintenance of the maximum amount of power needed, and the

*At the Paris Exhibition of Electricity 450 Swan Lamps were fed from Brush Machines, and 120 Swan Lamps from Siemens Machines. The conductor from the Brush machines weighed one-half as much as the conductor from the Siemens machines, the lengths being equal; that is to carry a low tension current from a Siemens Dynamo required a conductor nearly eight times as large as a conductor to carry a high tension current from a Brush Machine.

installation of works of corresponding magnitude. The works may be almost idle during eighteen hours of the twenty-four, but they must be maintained just the same, for in the business of furnishing illumination for domestic purposes, a station must be able to supply light just as the gas works do, at any hour of the day or night when needed. A full force of attendants, an adequate supply of steam for emergencies, whether of unexpected cloudy days, or misty mornings, and regulating apparatus that must involve more or less waste of current, are among the necessary requirements of such a system. It cannot be said that if at six o'clock ten thousand lights are running, and at ten o'clock but five thousand, the latter will cost half as much to operate, for much more steam in proportion will be required, counting the load of the engines and the friction of bearings, while the cost of attendance remains the same.

Again, if on a given circuit the total electrical resistance of all the lamps used on that circuit were to be equal to the total electrical resistance of the wires themselves, one half of the power delivered to such a circuit would be wasted. If on another circuit the total electrical resistance of the lamps in use should be nine times as great as the total resistance of the conducting wires only ten per cent of the power would be wasted. With this law in view any one can judge of the loss in any given circuit. The result of actual experiment demonstrates that even where very large conductors are used as much as two-thirds of the total electrical energy delivered to the circuit may be wasted, where a large number of lights are employed. All of the foregoing difficulties are overcome by using electral energy of high tension.

The best informed Electricians, understanding the great loss involved in a system such as described have long since become convinced that Electric lighting for domestic purposes in order to be practical must be aided by some method of conserving all, or nearly all, the energy created by the motive power, so that every revolution of the wheel of the Engine may find useful expression in light or transmitted power. It became evident that such a system would greatly reduce the amount of plant required, would increase the amount of light per horse power if delivered from a high tension machine, would utilize the full value of the services of attendants, and would inaugurate

A New Era

in the field of Electric lighting. It was conceded that something must be had which in an electric lighting system, or in an electromotive power system, would take the place represented by the gasometer in the gas-lighting system and by the accumulator in a hydraulic power system. The battery which will do this is now provided, and the application of electric currents will probably make more rapid advance from this time than it has done even within the past three years. The new battery may be made to meet any requirements. With such a battery a high current machine may be used to deliver a high tension current, at almost any distance from the generator, to the point where the electricity is demanded, and the current having been there discharged into the accumulator with scarcely a perceptible loss in transmission, can be drawn from the battery to supply the lamps. It is thus seen that a current of high tension involving very little loss in its transmission, is stored up or accumulated and is available for use with currents of low tension such as are required for incandescent lights.

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The Brush Storage System.

The subject of the Storage of Electricity is one that has received the attention and most careful study of Mr. Brush for several years past, and the complete system now presented to the public is the result of these years of patient labor and investigation.

When Mr. Brush began his researches the condition of the art was very crude, the only results attained being those of Plante, which were merely of scientific interest and without practical value. Among the earliest improvements made by Mr. Brush was the use of lead oxide in connection with lead plates. Another method of preparing or forming the plates was soon after discovered by him. His present system is the outgrowth of these discoveries, and is protected by more than twenty seperate and distinct patents. The Brush storage battery is simple in its construction, consisting of a box containing cells, in each of which are lead plates. The plates are electrically treated in a manner that is of course a secret, and are immersed in acidulated water. These plates are what are properly designated accumulators, and in them is stored the electricity. They are portable and can be packed and shipped as any other merchandise. They can be handled without danger, and can be made of any size required so that there is no theoretical limit to the amount of electricity that can be stored. The capacity of a battery depends upon the number of cells it contains and the size of the plates. The Brush system is complete in every respect; is a commercial as well as a scientific success; the loss of energy in storing and in again giving up electricity is comparatively small, and any required amount of electricity can be accumulated or stored and afterwards used either for light, power, chemical action, telegraphy, or for any other purpose for which electricity obtained from other sources is used. No doubt the principal use that will be made of storage batteries will be to furnish currents for incandescent lamps.

There are many difficulties to be overcome where the current from a dynamo machine is connected directly to the incandescent lamps, as has been demonstrated by experience. All these difficulties vanish, however, when the current from the machine is used to charge an accumulator or storage battery, and the incandescent lamps are fed from the battery. It is then immaterial whether one lamp is used at a time or all that a given battery is capable of supplying; they all burn with perfect steadiness and uniform power. Each lamp takes its exact proportion of the power, and no more, and there is consequently no waste, however slowly or rapidly the current is used. Where a dynamo machine is employed to supply incandescent lamps directly, it is found that if it requires ten-horse power to supply sixty lamps it will require more than than five-horse power to supply thirty lamps, and much more than two-horse power to supply twelve lamps with the same machine. Where a machine is not run constantly with its full complement of lamps it cannot therefore be operated as economically, the smaller the number of lights in use the larger amount of power each one takes, and this is true notwithstanding the use of current governors and similar devices.

The direct system of lighting is also subject to a great disadvantage due to the fact that in order to avoid the very serious loss of current caused by the electrical resistance of the conductors, where a number of lights are required at a considerable distance from the machine, it becomes necessary to use conducting wires of enormous size and corresponding cost, and to insulate them most thoroughly to avoid leakage.

Another great advantage of the storage system over the direct system arises from the fact that domestic and in-door lighting, where incandescent lamps will be mainly used, is ordinarily confined to

about six hours a day on an average, and yet usually some light is required throughout the night. Take for instance a given district to be lighted, requiring 10,000 lamps as a maximum. By the direct system of lighting it would be necessary to provide a lighting station with about 2,000 horse power of engines and boilers, and the corresponding dynamo machines and apparatus, and have the whole of this power in use during all the hours of darkness in which light would be required, for it would be impossible to know in advance how many lights would be required at any given hour. The lighting station must be so operated that the whole 10,000 lamps can be lit at any moment desired. During a large part of the time, however, as a rule, much less than the full number of lamps would be in use, and at such times the station would be running at a disadvantage. By the storage system this difficulty would be avoided, for it would only be necessary to provide enough storage batteries to run the full number of lamps for say six hours. Then if at any moment any less than the full number of lamps were in use the batteries would be giving off that much less current and would last that much longer without renewal. Then, too, a much smaller and less expensive plant in engines, boilers, and dynamo machines would be required at the station for they could be run for at least twenty-two hours out of the twenty-four, and if 2,000 horse-power running steadily for six hours would furnish all the current required for the 10,000 lamps throughout the night, 500 horse-power running twenty-four hours would furnish the same amount of current. In this way the items of cost of plant and interest on investment would be greatly decreased.

Another point of great importance is, that if any accident occurs at the lighting station where the direct system is used, whereby the engines or dynamo machines have to be stopped, all the lights stop until the difficulty is remedied. With the storage system, where each user of light has his own reservoir of electricity on his own premises, he is independent, to a great extent, of every other customer, or of the station, and a stopping of the machinery at the station for several hours would not stop his lights.

Each storage battery will be provided with an automatic switch, so arranged that when the battery needs charging, it will be automatically switched into the circuit of the dynamo-machine, kept in circuit until it is fully charged, and then cut out of circuit again. Attached to this switch will be the meter which will register the amount of current used. Each user of lights will have his own reservoir of electricity on his own premises and will be independent of other users or of the central station, so far as accidents are concerned. He will have his own meter and an automatic current-switch which will keep his battery fully charged.

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Example of the Value of Storage.

A large Cotton Mill such as the Pacific Mills at Lawrence, Mass., the Merrimac Mills at Lowell, or any establishment of similar size, if lighted by Incandescent Lamps would require a very large number of them, probally 10,000 to replace a similar number of gas burners. We will suppose such an establishment would require 10,000 Incandescent Lamps. This light would be needed on an average one hour per day or about three hundred hours per year, no light being required in summer time. An electrical apparatus capable of producing this amount of light, without the intervention of storage batteries would have to be of very great size, and would cost a large amount. It would require for its operation not less than one thousand horse power of engines and boilers and all the other accessories of a complete power plant. This enormous plant would all have to be provided and kept in perfect working order during the entire year; but would only be actually used during the three hundred hours of the year that the light was needed. It would, therefore be a non-productive investment during 8460 out of the 8760 hours in the year. And in addition to this great loss there would be a loss

of fuel in starting the fire under the boilers before the time of lighting to get up steam and a corresponding waste of fuel after the light was no longer required, before the fire died out. With the introduction of storage batteries, all this would be changed. The investment for the Incandescent Lamps and wires would be substantially the same as in the first instance, but an electrical apparatus would be needed only large enough to furnish and store up or accumulate an amount of electricity in the hours when no light was required, sufficient to run the Incandescent Lamps for the remaining hours when actually needed. In other words, other things being equal, an electric generator used in connection with storage batteries, and a power plant to drive it would not need to be more than one-tenth the size and cost of the plant first described. It would be a question of furnishing, keeping in order and runing one thousand horse power in one case for three hundred hours in the year, against, say forty or fifty horse power for the entire year, or to meet extra demands for longer hours, a maxium capacity of say 120 horse power. Most mills could spare the smaller amount of power without noticing it and could operate the plant at a very small cost. The great saving would be in the first cost, interest and wear and tear. An item of importance also, in comparing the two systems would be in the ABSOLUTE STEADINESS of the light furnished by the storage batteries, which cannot be equalled by lights running direct from a machine driven by the most perfect running engine in existence. ANOTHER ADVANTAGE is that no matter what accident or stoppage may occur to engine or machine, the consumer has always at hand, a certain supply of electricity ready for use.

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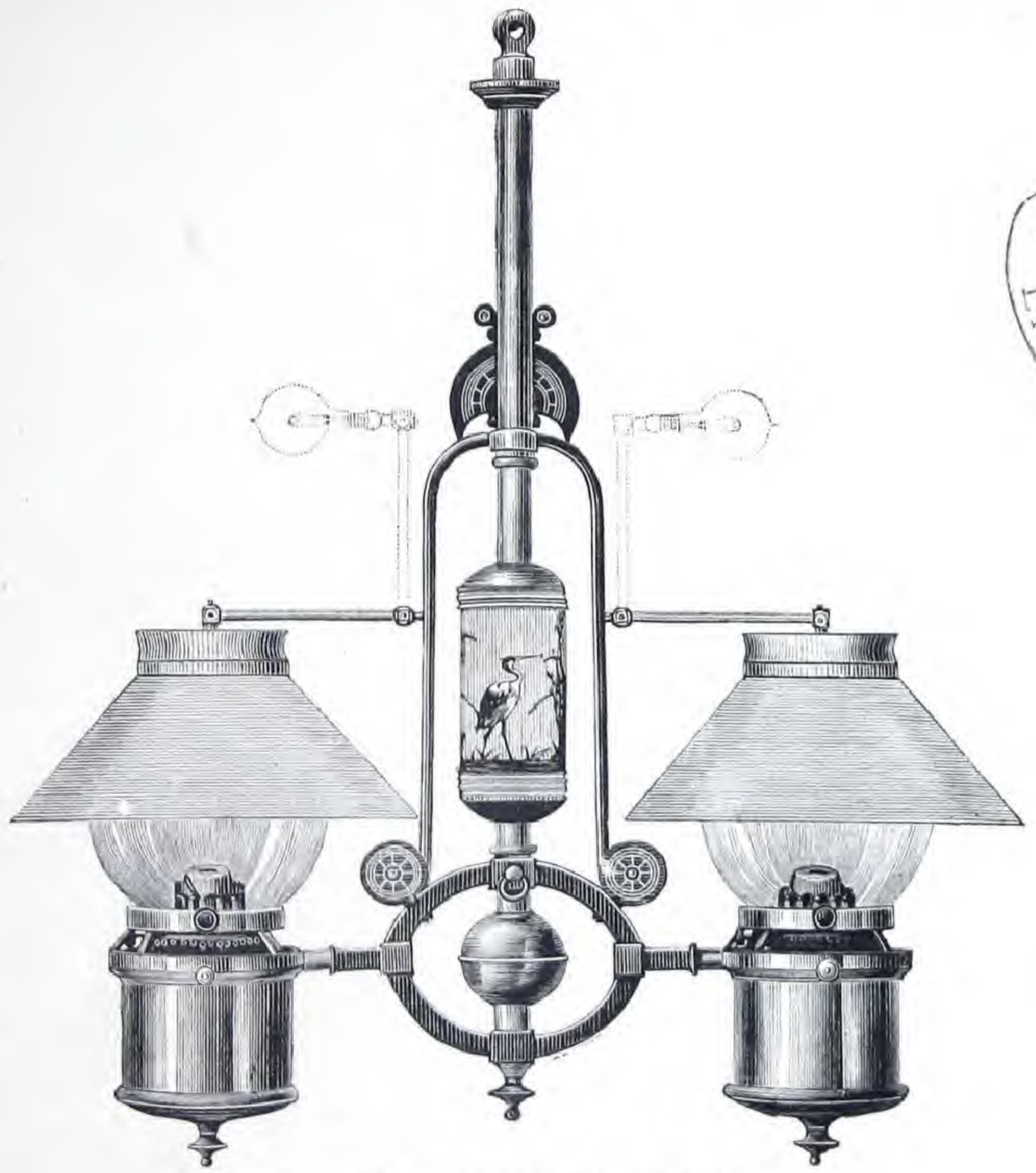

SWAN S. S. LAMP ADJUSTED TO OIL FIXTURES.

SPECIMEN ELECTROLIER—(M. V. & CO., N. Y.)

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Swan Lamp in Use.

The introduction of the Swan Lamp throughout Europe has led to its successful use in many industrial and public institutions as well as for domestic purposes. Installations of the most extensive character are being made daily throughout Great Britain, in the Colonies and on the Continent, and the leading journals of these countries unite in giving it precedence in extent, importance and usefulness over all other systems. In the preparation of this pamphlet it has been deemed advisable to reprint a few of the many flattering notices which appeared from time to time in the most respectable journals of Europe, the extracts so offered having all the great value of disinterested testimony.

Swan Incandescent Lamp.

In the Spring of 1881 a company was formed by Mr. Swan's own townsmen to enter upon the manufacture of his lamp. The fitting up of workshops and the organizing of a new manufacture, of necessity occupies time, but Mr. Swan, aided by his *collaborateur*, Mr. Stearn, proceeded energetically with the work, and in the autumn various installations of these lamps showed that the organization if not perfect, was sufficiently so for the rapid manufacture of the lamps. During the whole of the time the inventor was continually experimenting, and with the result that the lamp has been modified in form and very much improved. We mention the following installations recently made of these lamps. The Savoy Theatre, (1,200 lamps ; the British Museum ; the Rooms of the Royal Society ; the Editor's Room at the *Times* ; the house of the President of the Royal Society ; the Mansion House ; at the collieries of Risca and Earnock ; at the Coombe Bank ; at the residence of Sir W. Thompson, and in the following steamships : City of Richmond, H. M. S. "Inflexible," the Servia, the Alaska, the Coptic, the Arabic, &c.—*Electrician*, *Jan.* 21st, 1882.

Note.—From the spring of 1881 to the close of 1882, over 250,000 Swan Lamps have been manufactured and sold in England, and the Boston factory of the Swan Incandescent Electric Light Co. of the United States has been fitted up with a capacity to turn out about 10,000 lamps per week.

Swan Light in Theatres.

The Swan Lamp has been successfully introduced into theatres, and has been found very greatly to improve their acoustic properties and remedy the serious defects of improper ventilation :

Describing its advantages in the Savoy Theater, London, the *World* says : "It will, perhaps less interest the reader to know that two seperate engines provide 800 lights for the stage and the dressing-rooms and 129 lights for the auditorium, than to know that the incandescent lamp gives an agreeable, soft. not glaring light, advantageous for the colors and—mind !—for the complexion ; gives no heat, flickers not, smokes not, causes no dirt, and last, not least, cannot set fire to anything it comes in contact with, simply because the incandescent wire, heated white, is enclosed in a glass globe from which the air has been exhausted, this vacuum being one of the conditions of the burning. If, therefore, by any accident the globe should be broken, and the flame exposed, the mere rushing in of air would destroy its vital conditions and extinguish it."

Paris Figaro :—"The stage and auditorium of the Theatre des Varietes in Paris has been lit up with Swan lamps. Two hundred and sixty-five lamps are used and the result is most satisfactory." "The lighting of the Vaudeville Theatre on the Boulevard Montmartre has far exceeded the expectations of the most sanguine. In a double sense it is a brilliant event. Every night the hall is densely crowded."

Swan Lamps in Russian Theatres.

"The Direction of the Imperial Theatres in Russia has contracted with Mr. A. J. Rousseau, engineer, for the lighting of the whole of these theatres by electric lights, this system having been adopted as a precaution against fire. His Imperial Majesty, the Emperor, signed the concession on the 29th ultimo. Swan incandescent lamps will be used, with dynamo machines to supply the current."—*London Electrician Nov.* 25. 1882.

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Swan Light in Paris Opera House.

"A very successful installation of Swan lamps has just been made in the Opera House. The lamps have been placed in several parts of the building, but most prominently in the *foyer*. To light the *foyer* with gas, ten chandeliers, with 48 lights on each, were used—equivalent to about 4,800 candle power. Two of these chandeliers have been fitted with 48 Swan lamps each. These were run up to about 40 candle power, making a total of 3,840 candles for the two chandeliers—almost equal to the eight remaining gas lit chandeliers. The effect in the neighborhood of the electric light was very remarkable, and those who witnessed the trial expressed themselves highly pleased with the result.—*London Electrician, Oct.* 14, 1882.

Swan Lights at Birmingham Musical Festival.

"During the Musical Festival, the Town Hall, which has been used for the Festival, has been most brilliantly lighted by 500 Swan incandescent lamps. The current from the dynamo is conducted to the Hall by underground cables The lamps are fixed to specially designed brackets, and we may add that it is one of the largest and best pieces of electric lighting work that has of late been carried out."—*Birmingham Post, Sept.* 1, 1882.

Swan Light in Glasgow Post-Office.

"After a very exhaustive trial extending over nearly two years the Post-Office authorities have adopted the electric light throughout the whole of the General Post Office at Glasgow, and very elaborate arrangements have been for some time in progress by the Swan United Electric Light Company, which will result in the most complete installation of electric lighting yet attempted in Scotland. It will consist of ten dynamo machines, about twenty arc lamps and something like 200 Swan lamps. The driving power is to be obtained from a compound engine of 16 horse power nominal. After a protracted trial of the light, it has been found that not only is the atmosphere maintained in a much purer and cooler condition than when gas light was used, but that the light is much less trying to the eyes.—*Engineering-London, Nov.* 3, 1882.

Installations of Swan Lights in Glasgow.

"Messrs. Anderson and Munroe of Glasgow are very busy with installations of the Swan incandescent light. Including the work now in hand they have fitted during the past twelve months about 3,000 Swan lamps. One of their installations is the residence of Sir William Thompson; another of 400 lamps has just been completed at the extensive warehouses and offices of the East India merchants, Messrs. William Graham and Co. The large umbrella factory of Mr. J. D. Barker is lighted in the same way, and an installation has also been made at Murdostoun Castle, where gas has been entirely dispensed with.—*London Engineering, Nov.* 17, 1882.

Swan Lights at Birmingham.

"At the Birmingham Midland Institute a splendid display was recently made by Swan Lamps. In the lecture theatre some 55 lights were shown some being arranged on a central chandelier, which could be raised or lowered whilst the lamps were alight as required, and others on side brackets, as portable table lights, &c. This light has also been introduced into the Town Hall and the result is very pleasing."—*Birmingham Daily Post, Jan.* 21, 1882.

Economy of the Swan Electric Light in Mills.

"The flour mills of Messrs. Furlong and Sons and Messrs. Hall and Co. at Belfast were recently lighted with Swan's incandescent lamps. Both of these installations have been working most satisfactorily, and the report received yesterday stated that the light was much preferred to that of gas, that the dynamo machine gives no trouble, and that the duration of the lamps, has far exceeded anticipations, most of them having been in operation over 1,000 hours, and are as good now as when put up. The cost of working Messrs. Furlong's lights, has been returned as under 10s. per week, against £2 5s. per week paid previously for gas for similar hours of lighting.—*Belfast Letter Electrician, March* 28th, 1882.

Swan Electric Light in Shops.

The establishment of Messrs. Peter Jones and Co., Kings-road, Chelsea, S. W. has recently been fitted up with 200 Swan incandescent lamps. A portion of Messrs. Laing and White's premises in Holborn has also been lighted by means of Swan Lamps.

The Swan Light in Flour Mills.

A. R. Walker, Esq. of Newry, has decided to light up his extensive flour mills with the Swan incandescent light. This order is the result of the highly satisfactory system of installation in the mills of Messrs. Furlong and Sons, and Messrs Hall and Company at Cork in January last, these firms having expressed their great satisfaction with the Swan light.

Swan Light in Factories.

"The extensive wool works of Messrs. Ward J. Dow and Co. of Fairfax in Scotland have recently been lighted by means of Swan incandescent light."—*London Engineering, Oct.* 14, 1882.

"A portion of the Lace Finishing Works of Messrs. Capestake, Hughes, Crampton and Co. at Nottingham have for some time past been lighted by 16 Brush Lamps. The light given by this system has been so much appreciated by the employes and the firm that they have determined to introduce incandescent lamps into their rooms as well. Between 100 and 200 Swan lamps will, therefore, shortly be fitted up. The work required to be done by the hands is very fine and necessitated plenty of light, which must also be of good quality. The change from gas to electric light, so far as it has been tried at present, has been a great boon to the work people, affording as it does, a purer atmosphere for them to work in."—*London Electrician, Nov.* 25th, 1882.

Swan's Lamp in a Factory.

"Messrs. Guinness, Son and Co. of Dublin have had the looms in their new woolen factory lighted up with Swan's incandescent lights, the current being supplied by a dynamo machine. The result has been so satisfactory that this firm has given an order for the introduction of Swan lights into their extensive offices in connection with the breweries."—*Electrician, London, Nov.* 18, 1882.

The Electric Light in Cotton Mills.

"A series of very interesting figures on the cost of electric lighting in cotton mills in New England, as compared with the cost of illuminating with coal or oil-gas, has been collected by Mr. C. J. H. Woodbury, the expert of the Manufacturers' Mutual Fire Insurance Company. It is difficult to make a comparison between the various methods of illumination, because a change of light is always made an excuse for more light. Most mills are lighted with gas made by the destructive distillation of petroleum, and of about 80 candle-power, which is generally reduced to 60 candle-power by mixing air with it. The annual cost of oil-gas per burner is from 75 cents to $1. In all these estimates, interest at six per cent. forms one item in cost. One large corporation, with exceptional privileges, makes its coal-gas at an annual cost of 69 cents per burner. Another corporation, inland, makes its coal-gas at an annual cost of $1.79 per burner. Of two large mills in the same city, manufacturing similar goods, the more modern one makes oil-gas at an annual cost of 79 cents per burner, while the older one buys coal-gas at $2.65 per burner. The longer time the light is required, the less becomes the average cost, because, with the addition of operating expenses, the interest on plant, being a fixed amount, becomes a smaller proportion of the whole cost. A dark mill, that is, one of which the interior walls are not whitened, requires about twice the number of lights that are sufficient in a white mill, and uses light about one hundred hours a year more than a white mill. The cost of arc lights in several steam mills running 400 hours per year is 6½ cents per hour, of which 1½ cents are for carbons and 5 cents for attendance, coal, depreciation and interest. In a weave-room, on very fine work, 24 arc lights replaced 292 six-foot gas-burners, which consume (292x6) 1752 feet per hour; therefore, one arc light represents the consumption of (1752 ÷ 24) 73 feet of gas per hour. A careful estimate shows these arc lights to be costing 6½ cents per hour; therefore this arc lighting system represents gas at 89 cents per 1000. A similar estimate in another mill gives the annual cost of gas $2,188, and electricity at $1,125, or equal to gas at 90 cents per 1000. The annual saving to that mill in lighting expenses by the use of electricity makes a profit of $1,603, which represents six per cent on $17,716, without making mention of any inprovement in work or production due to that light. In the case of incandescent lights, the cost is more difficult to estimate, because they are run at all degrees of brilliancy, affecting both the power with the life of the lamp. Charles W. Lippitt, of Woonsocket, R. I., said that the Globe Mills had been supplied with the electric lighting system, which was much preferred to gas. For the season of 1881 and 1882, the company had used 117 large lights, running them for 367 hours, at an actual cost of $327.83. These took the place of 220 gas-burners, which, burning four feet of gas per hour for 367 hours, cost $710.60. The saving in favor of electric lights was $430.77, or an actual saving of 57 per cent. In another mill, oil-gas is used, and although it can be supplied at a lower cost, its results are not so good as coal-gas. The cost of running 220 burners of oil-gas for 367 hours is $473.11, which still leaves a margin of $145.28, or 31 per cent. in favor of the electric light. Col. Thomas Livermore, of the Amoskeag Mills, said that they had 5000 looms lighted with 465 electric lights, which had during the last eight months consumed 37,000 carbons. The average cost of each lamp per hour is 2.89 cents. He had found that one arc lamp could take the place of twelve gas-burners, supplying 12 looms with light. His mills manufactured colored goods, and a stronger light was found necessary to distinguish the colors. They had supplied fifteen carding and spinning rooms with the lights."—*Engineering and Mining Journal.*

A House Lit by a Waterfall.

"Sir William Armstrong's house in Scotland is now lighted with thirty pairs of Swan lamps of twenty-five candle power each, the source of power employed being a waterfall nearly a mile distant, driving a turbine of seven horse power.

It is probable that in most, if not in all cases where water is employed as the motive power, the introduction of an accumulator will be found desirable in order to insure perfect steadiness of light. The economy of the method is very great; and Sir William Armstrong states that no deficiency of either candle power or endurance in the lamps, will induce him to abandon the system."—*St. James Gazette.*

Swan Light in Mines.

"The Earnock Colliery has been lighted by the Swan Electric lamp. A dynamo machine supplies the current 200 yards distant from the pit head. The conductors employed are as follows: From the dynamo to the mines there is a $\frac{3}{8}$ in. copper rope, bare, and carried on poles by porcelain and vulcanite insulators. Down the shaft the cable is made of nineteen No. 22 copper wires, insulated by gutta percha, taped and tarred and enclosed in a galvanized iron tube $\frac{1}{2}$ inch in diameter. The wires leading to the lamps are of No. 14, 16, 18 or 22 according to the length of lead. The length of circuit is about two miles. The fixed lamps are suspended from the roofs of galleries and the portable lamps are attached to flexible conductors for convenience of shifting."—*London Engineering, Aug.*, 1882.

Effect of Swan Light on Pictures.

"M. Decaux has studied the resistance of colors fixed on tissues to agencies tending to alter them when submitted to their action. With reference to the electric light, he finds that its effect on colors fixed in wool by a dyeing process, as well as those of water and oil paintings, is similar to that of day light. but less energetic according to the means employed to produce it. In his experiments the colors were exposed for 1,500 hours to the light of a voltaic arc 200 candle power at a distance of 1.50 metres under thin glass. The effect was about four times weaker than that of the sun's light."—*London Electrician, May*, 1882.

"Recently Swan's incandescent lamps were used for the first time to light Hans Makart's colossal painting of Diana's Hunting Party, in the Central Exchange Art Gallery, New Castle. The effect was superb and every shade of color was brought out with marvellous distinctness."—*New Castle Chronicle, March* 20, 1882.

Installation of Swan Lights in France.

La Lumiere Electrique of Nov. 1st, 1882 says: that a recent installation of 120 Swan lamps has been made in the Spinning Mills of M. A. Lefebre at Seclin, and one of 30 Swan lamps in the Sugar Refinery of MM. D. Dersu and Co. at Epanan Court.

La Lumiere Electrique states that the works of Mr. Lazare Weiller, of Angouleme, comprising foundries, rolling mills and wire drawing establishment, have recently been completely lighted by electricity. The shops are lighted by arc lamps, and the engine room, offices and laboratory by Swan incandescent lamps.—*Engineering, London, Nov.* 24. 1882.

In addition to the above, the lighting of the Palace at Lille, and the engineering works of Saint Andre are also in progress.

Mansions, Public Buildings and Business Premises Fitted up with Swan Light.

Hatfield House, the Seat of the Marquis of Salisbury; Cragside, the residence of Sir Wm. G. Armstrong; Castle Huntley, the residence of W. Spottiswoode, Esq., the Hosiery and Drapery Establishment of Messrs. Coxon & Co., Newcastle, and Mr. G. H. Hovey, Sheffield; the Leather Works of Messrs. Pulman, Godalming; the Buckton Vale Dye-Works of Messrs. Gartside & Co.; the Sugar Refinery of Messrs. Macfie & Co., Liverpool; the Severn Tunnel Works; the Channel Tunnel Works.

Swan Light on Ships.

The introduction of the Swan Lamp into large Steam-ships as a means of illumination, has proven so very successful that, although little more than a year has elapsed since the first ship was lighted with them, they have been introduced into the largest steamers of the principal steam-ship companies, and in fact no steamer can be considered complete which is not lighted in this manner.

It is hardly necessary to point out the great advantages this means of illumination possesses over the oil lamps generally used, With the Swan Lamps a pleasant, soft white light is obtained, with this great benefit, that there is none of the heat and smell which are so specially objectionable in the cabins and saloons of steamers.

Swan Lights on Cable Ships.

"Mr. W. F. King, engineer in charge of the India Rubber Company's S. S. "Dacia" reports from Rio Janeiro, under date of December 19th, that the Swan lights on board have given so far great satisfaction, and furnish a beautiful and steady light in the saloon."—*London Electrician, Jan.* 21, 1882.

Swan Light in the Royal Institution.

"The electric light is, we understand, to displace the old Sun burners in the theatre of the Royal Institution, Albemarle Street, during the forthcoming Christmas and Friday evening lectures. The Swan lamp is now festooned along the gallery front, being strung between the beaks of brackets, representing a species of "Swan with two necks." Other lamps are fixed in the circular roof; their light being directed, by means of a parabolic reflector, strongly upon the screen opposite the audience. It has been found that 40 incandescent lamps thus disposed, light the theatre as effectually as the 150 gas jets hitherto employed."—*Engineering London, Nov.* 24. 1882.

Swan Electric Light on Board Ship.

"The Cunard Company evidently believe in the Swan lamp as a means of lighting the saloons and interiors of their vessels; several of them being now fitted up with Swan incandescent lamps. The latest addition to the fleet, the "Pavonia," is lighted throughout with Swan incandescent lamps, each State room having one of these lamps, which can be turned on or off at the pleasure of the occupant."—*London Engineering.*

Swan Lamps on Board the "Alaska."

"After an extended trial of the electric light on board the "Alaska," orders have been given for a complete installation of 300 Swan lamps in the ship, every one of the passengers' and officers quarters being lighted by them to the entire exclusion of oil and candles. Very special attention is paid to the illumination of the engine-room. There are three lamps in the screw-shaft alley, and thirteen beside the gauge glasses of the boilers. Lamp sockets are fitted near various parts of the engines that require occasional attention, such as the glands, and the men are provided with loose lamps in very strong globes, and of such a size that they can be carried in a jacket-pocket, and slipped into the socket when required."—*London Engineering, Nov.* 3, 1882.

The Swan Lamp on Shipboard.

"A steel paddle steamer called the "Lonsdale" has just been built at Greenock, 200 ft. long, 25 ft. beam and 10 ft. hold, and intended to be very fast. She is being fitted throughout with incandescent lamps by The Swan Electric Lighting Co.

The "Invicta," a new steamer recently built for the London, Chatham and Dover Railway Company is lighted by means of Swan's incandescent lamps in the saloons, engine room and other parts between decks."—*London Electrician, Aug.* 1882.

The Steamship "Antonia Lopez" built for the Transatlantic Company of Barcelona, has been fitted with Swan incandescent lamps, seventy of which are distributed throughout the saloons and passages.

Partial List of Ocean Steamers Fitted with the Swan Lamp.

S. S. "City of Richmond,"	Inman Line.
S. S. "Servia,"	Cunard Line.
S. S. "Cephalonia,"	
S. S. "Pavonia,	
S. S. "Arabic,"	White Star Line.
S. S. "Coptic,	
S. S. "Chimborazo,"	Orient Line.
S. S. "Orient,"	
S. S. "Cotopaxi,"	
S. S. "Austral,"	
S. S. "City of Rome,"	Anchor Line.
S. S. "Alaska,"	Guion Line.
S. S. "India,"	British India Steam Navigation Company.
S. S. "Goorkha"	
S. S. "Rewa"	
S. S. "Manapouri,"	Union Steamship Company of New Zealand.
S. S. "Wairarapa,"	
S. S. "Antonio Lopez,	Compania Transatlantica.
S. S. "Invicta,"	L. C. and D. Railway Company.
S. S. "Lonsdale,"	Capt. James Deane.
S. S. "Faraday,	Messrs. Siemens Bros.

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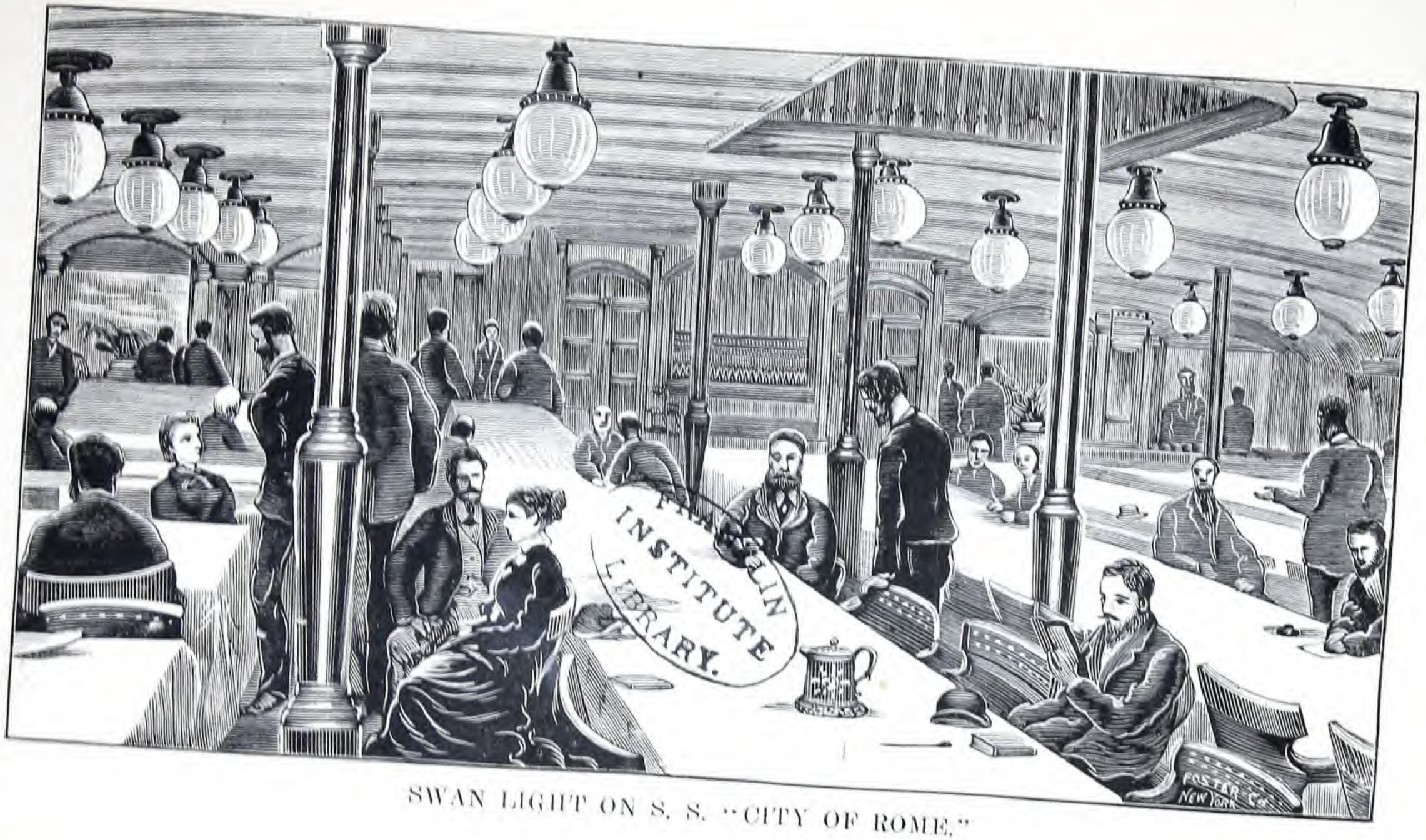

SWAN LIGHT ON S. S. "CITY OF ROME."

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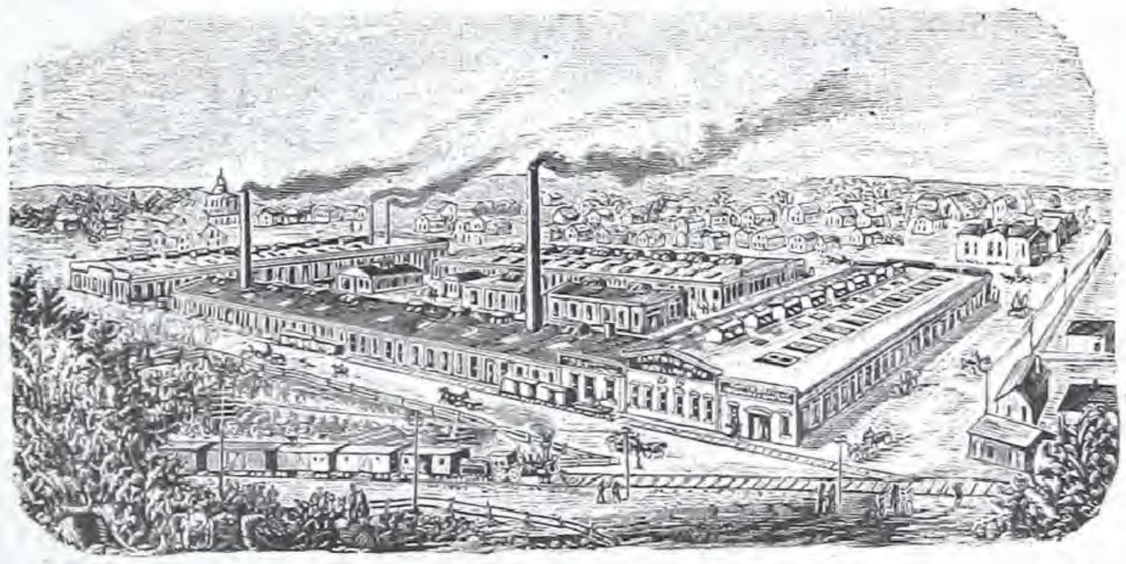

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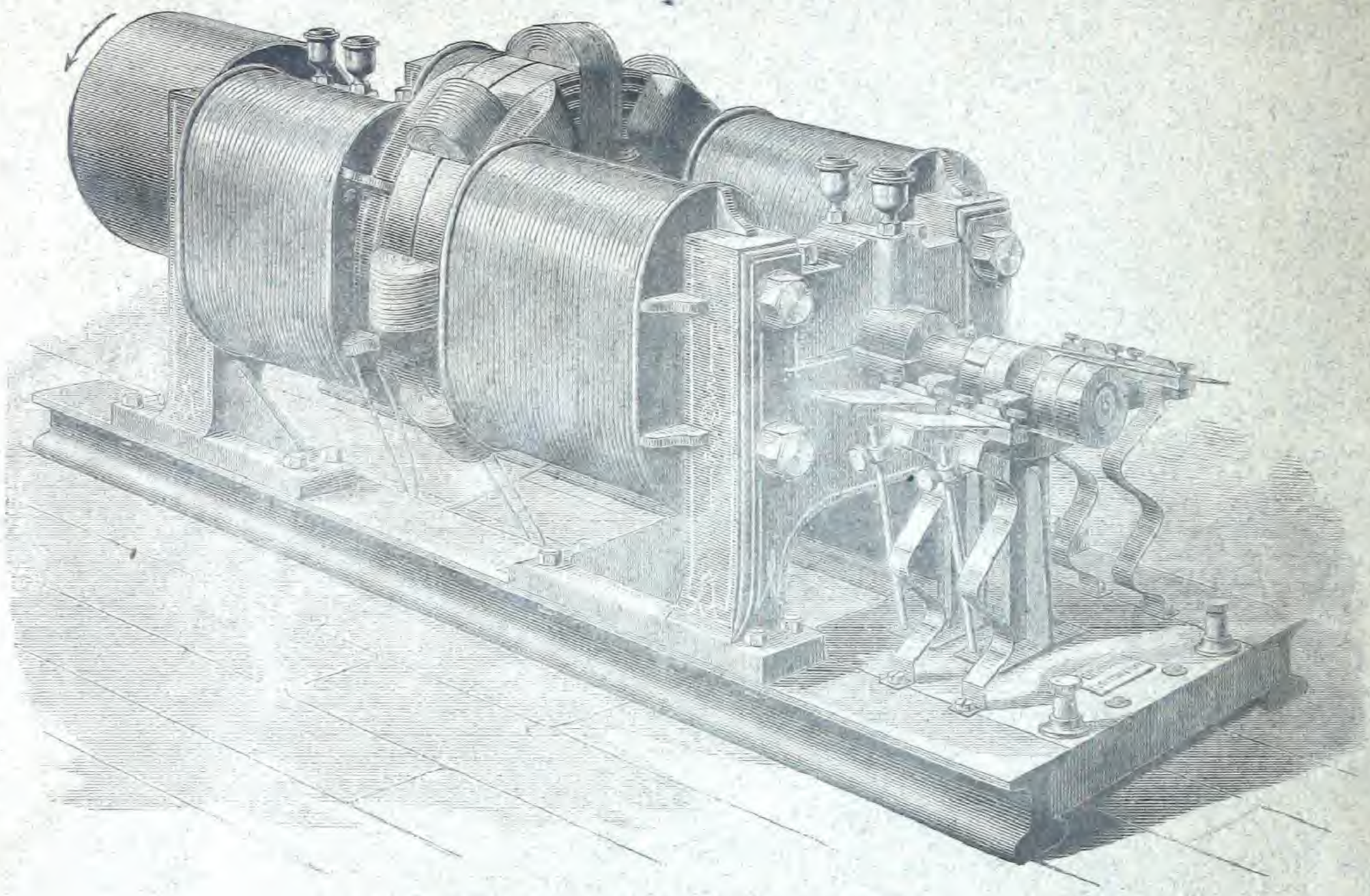

BRUSH DYNAMO MACHINE.